

## Sandia National Laboratories Laboratory Directed Research and Development

We welcome your questions, comments, and ideas for future LDRD projects to feature! Email your feedback to Marie Arrowsmith, [mdarrow@sandia.gov](mailto:mdarrow@sandia.gov)

### The "LDRD Inside" of Sandia's 2015 R&D 100 Award Winners

#### Lightweight Distributed Metric Service (LDMS)

Lightweight Distributed Metric Service monitoring software provides detailed awareness of the system-wide performance of high performance computers and applications in production environments. Sandia PIs include LDRD participants **Jim Brandt**, **Ann Gentile**, and **Benjamin Allan**. External PIs include Tom Tucker, Narate Taerat, and Nichamon Naksinehaboon (Open Grid Computing Inc.). Early funding was provided by Sandia's LDRD program, with later investments by DOE.

One LDRD that contributed to the success of LDMS—*Architecture- and Resource-Aware Partitioning and Mapping for Dynamic Application*—investigated adapting computer applications and systems to dynamic environments. This LDRD (2012-2014; PI **Karen Devine**) focused on combining static architecture information and real-time system state with algorithms to conserve power, reduce communication costs, and avoid network contention. The research team developed new data collection and aggregation tools, along with application interfaces to connect data with processing algorithms.

#### CO<sub>2</sub> Memzyme

CO<sub>2</sub> Memzyme is an ultra-thin membrane that is the first cost-effective technology for carbon dioxide separation and capture to meet and exceed DOE targets for helping to reduce the threat of climate change. The new memzyme surpasses earlier technology by capturing more carbon dioxide, faster, from a gas mixture while simultaneously producing nearly pure CO<sub>2</sub> (99%) for industrial re-use. This invention also won the R&D 100 Green Technology Special Recognition Gold Award. The PIs include LDRD participants **Susan Rempe** and **Jeff Brinker**, as well as UNM researcher Ying-Biang Jing.

Sandia's LDRD program provided initial funding via several projects, including: *Computational and Experimental Platform for Understanding and Optimizing Water Flux and Salt Rejection in Nanoporous Membranes* (2008-2010), Susan Rempe (PI) and *Programmable Nanomaterials for Reversible CO<sub>2</sub> Sequestration* (2010-2012), Patrick Brady (PI). Follow-on funding came from DOE's Basic Energy Sciences, DTRA's Joint Science and Technology Office, and the Air Force Office of Scientific Research.

#### Integrated Circuit Identification

IC ID, or Integrated Circuit Identification authenticates integrated circuits, detects counterfeit electronics and verifies individuals' identities and their transactions using a unique device signature and cryptographically secure challenge-response protocol. PIs include LDRD participants **Jason Hamlet**, **Todd Bauer**, and **Lyndon Pierson**. Sandia's LDRD program funded the technology's development via several projects, including:

*Security-enabled Programmable Switch for Protection of Distributed Internetworked Computers* (2005-2006), PI: **Jamie Vanrandwyk**. Researchers created hardware and software architecture that enforces security policies by pushing security functions closer to the end user without interfering with desktop environments via development of a specialized programmable Ethernet network switch.

*Infrastructure for Nondestructive, Real-Time Fingerprinting of Integrated Circuits* (2009), PI: **Lyndon Pierson**. Researchers developed a technology that provides a foundation for implementing new protection measures for integrated circuits. By enabling detection (and thus deterrence) of component substitution, the trustworthiness of even widely deployed hardware is greatly improved.

*Physically Unclonable Function (PUF) Based Software Authentication and Component Binding* (2010), PI: **Jason Hamlet**. Researchers designed approaches for binding integrated circuits (ICs) to one another, and binding ICs to software, with a focus on robust authentication methods. They also developed algorithms to efficiently bind factors in multifactor authentication schemes and to bind ICs to physical items to ensure the integrity of said physical items.

*Reliable PUFs for Supply Chain Assurance* (2011-2013) PI: **Todd Bauer**. Researchers developed methods of consistently achieving PUFs with required variation characteristics in certain gates and circuits, assuring that the circuits (and gates) demonstrated sufficiently high inter-device variation and sufficiently low intra-device variation over a range of environmental conditions.

#### LDRD PROJECTED BUDGET AND STATUS

FY16 Q1 \$155 MILLION 332 PROJECTS FUNDED AT \$144.4 MILLION

#### Upcoming Events

Jan 22, 2016 - FY2017 Standard and Grand Challenge Call for Ideas opens  
Jan 26, 2016 - FY2017 LDRD Program Town Hall  
Feb 3, 2016 - Grand Challenge, New Ideas, Exploratory Express Infosession